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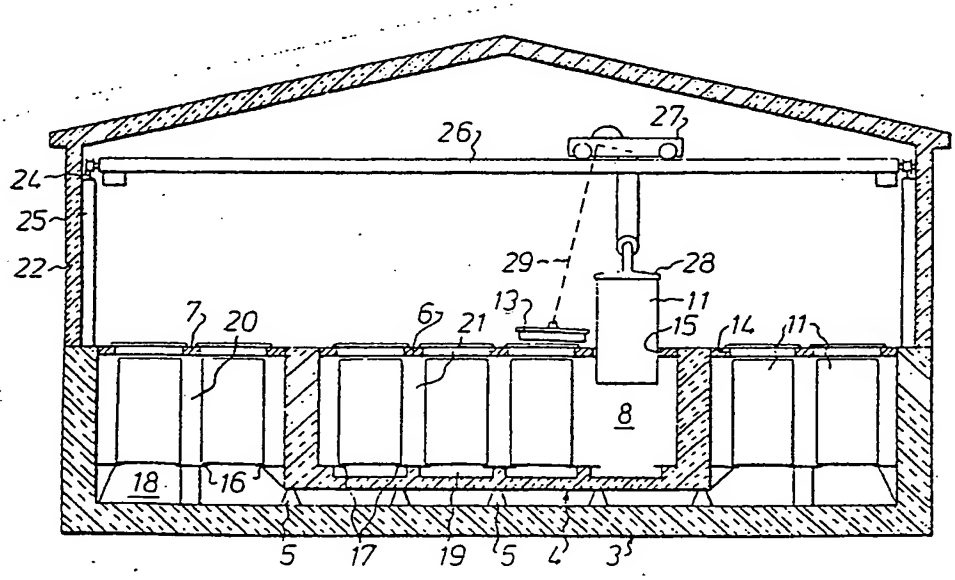


(57) Abstract

A plant for storage of goods intended to be stored at different temperature levels, especially freeze storage and cold storage, including storage compartments adapted to receive pre-loaded containers, to and from which compartments the containers are moved by means of a handling apparatus permitting vertical movement. The novelty is that one or more storage compartments (8), which can be opened upwards and are intended for goods having a storage temperature strongly deviating from the ambient temperature, are arranged inside one or more compartments constituting a climatic barrier and suitably formed as upwardly openable bearing compartments (9) for goods having a storage temperature less deviating from the ambient temperature, and that a part (1) of a building or the like containing the storage compartments is especially adapted to be surrounded on all sides by a medium having a temperature which is approximately constant independently of the times of the year and like variations.

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# STORAGE PLANT

The present invention relates to a plant for storage of goods to be stored at different temperature levels, especially freeze storage and cold storage, including storage compartments adapted to receive previously loaded containers, to and from which compartments the containers are conveyed by means of a handling unit permitting vertical movement.

Conventional freeze houses usually consist of a thoroughly insulated hall building in which there are arranged rows of shelf-like stands or racks separated by aisles. To obtain the required space for the operation of handling tools or vehicles it is often necessary to have longitudinally and transversely extending aisles. In prior art freeze houses it is possible to utilize only about 60 % of the floor area for storage while the rest is transport and handling areas.

For optimum utilization of the freeze house volume use is made of very high stands which, however, often makes it necessary to increase the aisle width with regard to the fact that the handling tools or vehicles must be broad to provide the required stability. This is not applicable to track-bound handling means which bear on rails on the stands.

In conventional freeze houses the air change rate is high and one essential reason therefor is that cold air will leak out and is to be replaced every time doors or the like are opened.

From the point of view of staff welfare, conventional freeze houses are troublesome since the staff must all the time stay in a temperature which generally is about -30°C. This involves a risk of frost injuries even if protective clothing is used.

If freeze house halls of today's design are to function as planned also during hot summer days it is

necessary to provide an extensive insulation. During the major part of the year a considerably less extensive insulation would be sufficient but the insulation will have to be dimensioned to cover the most unfavourable case.

To eliminate the risk of frost-formation with the accompanying risk of ground movements the freeze house floors must be insulated very thoroughly downwards. To reduce the ground insulation, as suggested in the normal case, and lay in frost-preventing heating coils which obviously increase the total energy consumption can hardly be considered a rational solution of this problem.

A fact causing problems in calculating and constructing freeze house walls is the high temperature difference between the outside air and the interior of the freeze house. In hot summer days this difference may amount to more than $60^{\circ}$ while in winter it may vary between 10 and $30^{\circ}$. This problem may be solved by allowing the maximum outside temperature to be decisive for dimensioning, and by basing the insulation capacity on the resulting temperature difference. It is also possible to slightly reduce the insulation capacity and instead give the freeze machines such a large over-capacity or, alternatively, double the number of freezing machines so that these, when necessary, can supply such a large amount of cold air that the lack of insulating capacity will be compensated for.

The object of this invention is to provide a storage plant, especially for freeze storage, while eliminating the inconveniences entailed with conventional freeze houses.

The essential characteristic of the storage plant according to the invention is that one or more storage compartments, which can be opened upwards and are intended for goods having a storage temperature which strongly differs from the ambient temperature, are arranged inside one or more compartments which constitute a climatic barrier and suitably are designed as upwardly openable storage compartments for goods having a storage temperature which is

less different from the ambient temperature, and that a part of a building or the like, containing the storage compartments, is especially adapted to be surrounded on all sides by a medium having a temperature which is approximately constant independently of the various seasons and the like.

Great advantages concerning energy are gained by arranging the plant for vertical displacement of storage goods down into and up from the storage compartment and by positioning the storage compartment under the handling compartment. Introduction and lifting out of goods do not cause any cold-air leakage. As the storage compartment for deep-frozen goods is surrounded by a storage compartment for cold-stored goods, there are obtained temperature differences that are favourable from the point of view of insulation between, on one side, the freezing compartment and the cooling compartment and, on the other side, between the cooling compartment and the environment, which, in total, will reduce the insulation costs. As the building section containing the freezing and cooling compartments is submerged in the ground or, in an alternative embodiment, in water, one may reckon with a substantially constant dimensioning outside temperature and this will have a favourable influence on the insulation cost as well as on the need of over-capacity of the freezing and cooling units.

The overlying handling compartment may be of a comparatively simple design with low demands for insulating capacity in walls and ceiling since the goods will only momentaneously be situated therein. In the handling compartment the temperatu need not be essentially lower than normal room air temperature, which means that the staff need not use protective clothing.

Calculations made on the basis of climatic conditions corresponding to those prevailing in the Middle East and an imagined storing capacity amounting to 1016 ton result in a reduction of 40 % as concerns the building area and 60 % as concerns the building volume. The most obvious reduction, however, concerns the required energy where, with the same storing capacity, a saving of no less than 85 % is gained.

The background of these favourable figures is, int. alia, as follows.

As it is not necessary to provide the freezing and cooling compartments with transport and aisle doors on floor level, the energy loss of 40-50 % and 20-25 % respectively, which would otherwise occur, is saved.

As no staff people will stay in the freezing and cooling compartments no lighting is required therein. Lighting fittings in conventional storage plants imply heating - 93 % of electric energy supplied to lighting fitting is converted into heat - and this heat addition must be eliminated by energy supply to the freezing and cooling units.

In the freezing and cooling compartments of a plant according to the invention, temperature and air movements are under complete control and the risk of uncontrolled air movements is entirely eliminated. This means that it is possible to offer a better control of the storage and thus obtain a higher product quality than in case of conventional plants where the air temperature always varies due to uncontrollable air movements caused by opening of doors and the like and where fresh supply of cold air from the outside - with the accompanying condensation and frost formation problems - must take place constantly.

Contributory to the favourable figures as regards saving of energy is of course the fact that "waste" from the freezing section can be utilized in the cooling section of the plant and reduce the energy demand there.

Other characteristics and advantages of the plant according to the invention will appear from the following description.

An example of embodiment of a plant according to the invention will be described more fully below with reference to the accompanying drawings, in which:

Fig. 1 is a cross-section of a schematically illustrated plant according to the invention;

Fig. 2 is a partially sectional side view of the same pla

Fig. 3 is a schematic perspective view of a ground-based

embodiment of a plant according to the invention;

Fig. 4 is a corresponding view of a floating plant according to the invention;

Fig. 5 is a partially cut-out perspective view of a preferred embodiment of such a plant;

Fig. 6 shows a diagram illustrating the energy consumption in plants arranged according to the invention as compared to the energy consumption in conventional plants with corresponding storing capacity; and

Fig. 7 shows schematically a preferred embodiment of the handling unit.

The plant consists of a sub-structure 1 and a superstructure 2.

The sub-structure is built up of an outer box-shaped part 3 and an inner box-shaped part 4 arranged therein. Walls and bottom of both the outer part and the inner part 3 and 4, respectively, are made of resistant heat-insulating material. The inner box-shaped part is supported by columns or feet 5 so that its bottom 3' is spaced from the bottom 4 of the outer part. Alternatively it is possible to utilize a concrete layer which is insulated from the bottom of the part 3 and has a large number of horizontal channels passing therethrough. The upwardly facing opening of the inner part 4 is crossed by beams or the like 6 so that the opening will be divided up into a number of smaller openings, and in the same way the upwardly facing opening of the outer part 3, which opening surrounds that of the inner part, is crossed by beams 7.

The compartment 8 in the inner part is designed for freeze storage of goods while the compartment 9, which also serves as a climatic barrier, is designed for cold storage of goods.

The compartments 8 and 9 have separate cooling and freezing units which may be placed in the compartment designed by 10 or be allowed to occupy part of the respective compartments 8 and 9.

The freezing and cooling compartments 8 and 9 are

adapted to receive a large number of containers 11 which are carried down through the openings 14 and 15 normally covered by doors 12, 13 and rest on supports 16 and 17 respectively, e.g. perforated metal sheets, so designed that air passages 18 and 19 respectively are formed under the containers. Vertical air passages 20 and 21 are also provided between the containers. The freezing air and the cooling air are introduced at the bottom and allowed to circulate under and around the containers which should be of air-permeable type.

The super-structure 2 consists of a hall building having moderately insulated walls 22 and roof 23. Arranged along the long sides of the hall are overhead rails 24 supported by columns 25 and running thereon is an overhead beam 26 along whichan overhead travelling carriage 27 is movable. The travelling carriage carries a lifting yoke 28 provided with quick locking means adapted to co-operate with complementary quick locking means in the containers 11. The travelling carriage can also carry a bow 29, indicated by dashed lines in Fig. 2, with coupling means for lifting and swinging away the doors 12, 13, while lifting and inserting containers 11.

Only people handling the travelling crane need stay in the hall building. It is also possible to utilize remote control of the travelling crane and electronic control of it by means of a computer which, on the basis of the command fed into it and stored data regarding goods situated in the compartments, can insert or take out the desired container on order. Containers are collected from, and left to other transport means at the loading bridge, designated by 30, or directly on the platform of a vehicle.

The invention may be varied in several ways without departing from the inventive concept. In addition to the fact that the plant, as has already been mentioned and is shown in the drawings, can be placed on or, more exactly, b submerged in the ground, it may be made floating, as appears from Fig. 4. This embodiment is especially applicable to

season-bound use when the plant can be moved, if required.

According to the preferred embodiment shown in Fig. 5, the storage section of the plant is built up of a number of preferably prefabricated cassette-like units 31 which can be placed in a relatively simple outer shell built in situ. It is also possible to use a prefabricated outer shell. In the illustrated embodiment only the compartments 8, i.e. the freeze storage compartments, are formed of cassette-like units 31 while the cold storage compartments 9, constituting the so-called climatic barrier, are situated around said units inside the outer shell 3 provided with an appropriate insulation. Also the compartments 9, however, can be formed of units similar to cassette units, thus gaining the advantage that the storage plant will be more flexible. In that case cassette units 31 can be utilized, as required, for freeze or cold storage by re-switching of the freezing and cooling units. This flexibility is especially valuable in areas where the varying needs of freeze and cold storage are dependent on the season.

To simplify the build-up and the maintenance the freezing and cooling systems 32 should be disposed in units which are easy to disassemble so that they can be moved as required. For reasons of reliability in operation several units should be used so that, if a separate unit is out of order, it will still be possible to maintain the required freezing efficiency.

The diagram shown in Fig. 6 illustrates the energy demand in plants having a corresponding storing capacity and designed so that 40 % of the plant is utilized for cold storage while 60 % is utilized for freeze storage.

The invention permits storing deep-frozen goods as well as goods to be cold-stored, at a substantially reduced energy cost within a volumetically substantially reduced space.

In the preferred embodiment of the handling apparatus shown in Fig. 7, the overhead travelling carriage 27 running on the overhead beam 26, which in turn can be moved along

the overhead rails 24, is provided with a rigidly arranged guide equipment 33 comprising an inner structure provided with guide rolls or the like and an insulation arranged around said structure. The guide equipment 33 provided with a surrounding insulation extends so far down towards the floor in the hall building that a free space is left with a height slightly exceeding the height of a load carrier, a load pallet or the like 34. In this embodiment the containers 11 consist of frame structures 35 provided with abutments to support a number of load carriers 34. By the use of a handling apparatus similar to that of Fig. 7 an advantage is achieved in that only one load carrier at a time is exposed to the air in the hall building. Some of the load carriers supported by the frame structure 35 are still situated in the freeze compartment and some in the inner part of the insulated guide equipment, while only one load carrier stands free, i.e. that one to be taken out or just is being inserted in the frame structure. The load carriers and consequently the goods will thereby be exposed to the air as little as possible, which improves the storing quality.

The invention must not be considered restricted to that described above and shown in the drawings but may be modified in various ways within the scope of the appended claims.

CLAIMS

1. A plant for storage of goods intended to be stored at different temperature levels, especially freeze storage and cold storage, including storage compartments adapted to receive pre-loaded containers, to and from which compartments the containers are moved by means of a handling apparatus permitting vertical movement, c h a r a c t e r i z e d in that one or more of the storage compartments (8) which are openable upwards and designed for goods having a storage temperature strongly deviating from the ambient temperature, are arranged inside one or more compartments forming a climatic barrier and suitably designed as upwardly openable storage compartments (9) for goods having a storage temperature which is less deviating from the ambient temperature, and that a part (1) of a building or the like, containing the storage compartments, preferably is designed to be surrounded on all sides by a medium having a temperature which is approximately constant independently of the times of the year or the like.

2. A plant as claimed in claim 1, c h a r a c t e r i z e d in that the part (1) containing the storage compartments (8, 9) is mainly intended to be situated below the ground level (Fig. 3).

3. A plant as claimed in claim 1, c h a r a c t e r i z e d in that the part containing the storage compartments (8, 9) is intended to be at least partly situated below a water level (Fig. 4).

4. A plant as claimed in any of claims 1-3, c h a r a c t e r i z e d in that arranged above the part (1) containing the storage compartments is a hall-like super-structure (2) provided with doors or the like.

5. A plant as claimed in claim 4, c h a r a c t e r i z e d in that arranged in the super-structure (2) is at least one overhead travelling crane or like apparatus (24-28) permitting vertical and horizontal transport.

6. A plant as claimed in claim 1, c h a r a c t e r - i z e d in that the compartments (8, 9) are intended to receive a large number of containers (11) and that covers or the like (12, 13) are arranged above the compartments and can be individually opened or swung away thus uncovering a space for a container (11).

7. A plant as claimed in claim 5, c h a r a c t e r - i z e d in that arranged in the storage compartments are abutments or the like (16, 17) which are adapted to uncover air passages (18, 19 and 20, 21 respectively) under and preferably also on the sides of part compartments intended to receive containers (11).

8. A plant as claimed in claim 1, c h a r a c t e r - i z e d in that the inner storage compartment (8) is defined by walls and the bottom (4') is spaced from the walls and bottom (3') of the outer storage compartment (9) and is supported by thermal-bridge preventing means (5).

9. A plant as claimed in claim 1, c h a r a c t e r - i z e d in that the handling apparatus includes a guide equipment with surrounding insulation rigidly arranged on a per se known overhead carriage and extending downwards from the overhead carriage towards the level of the openings of the storage compartments and uncovering between itself and said level a compartment of a height substantially corresponding to the height of a load carrier, pallet or the like.

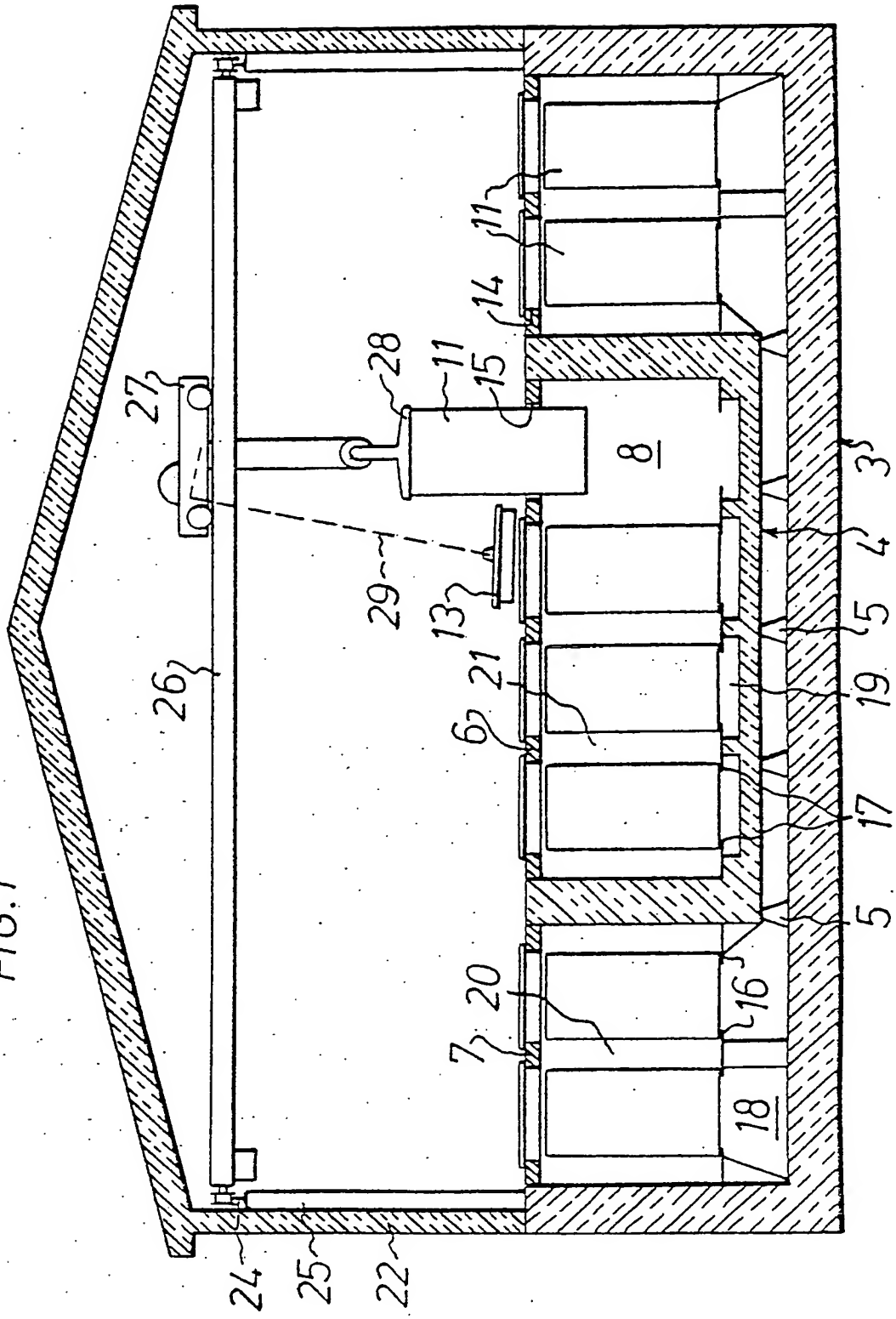



FIG. 1

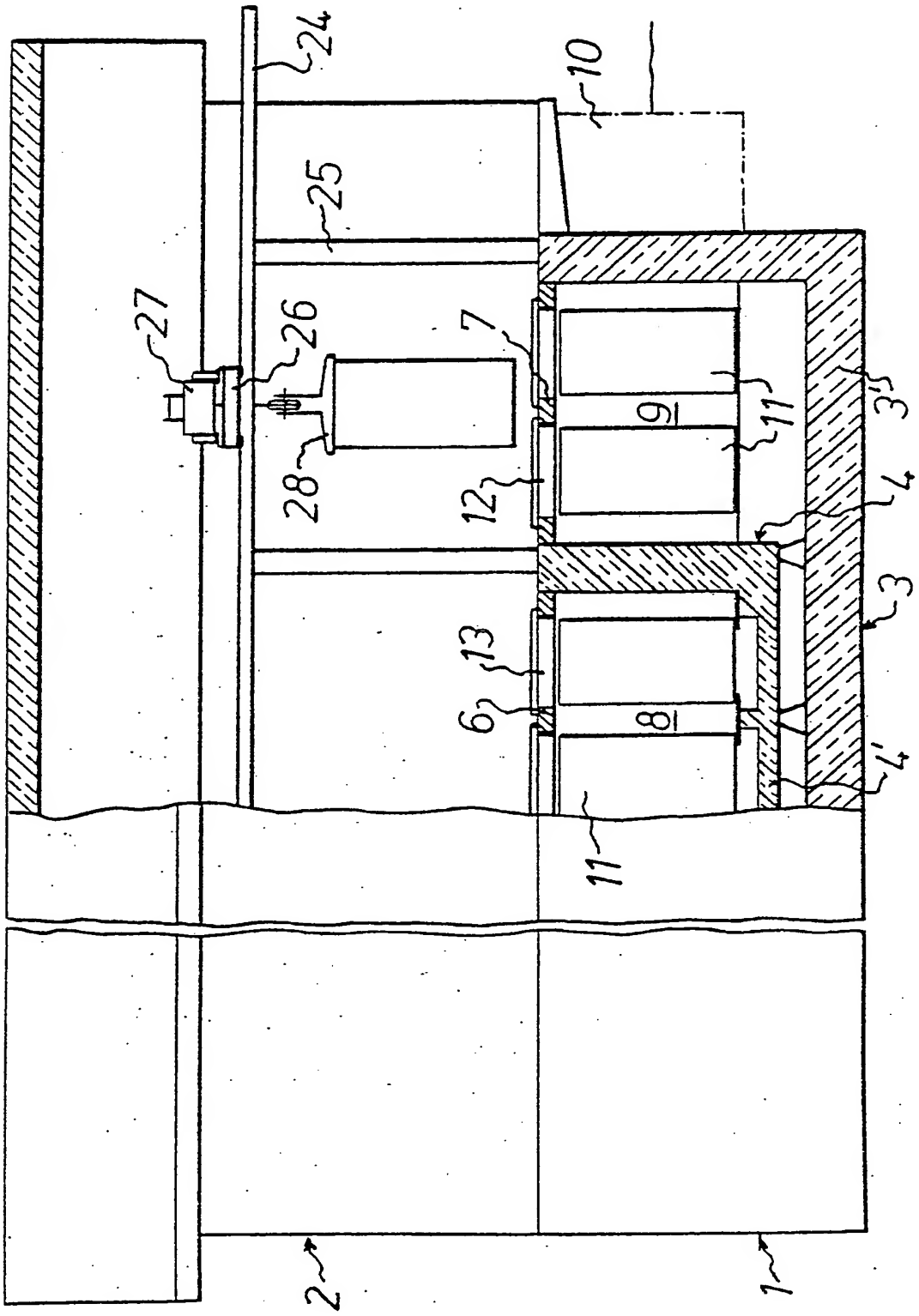



FIG.2

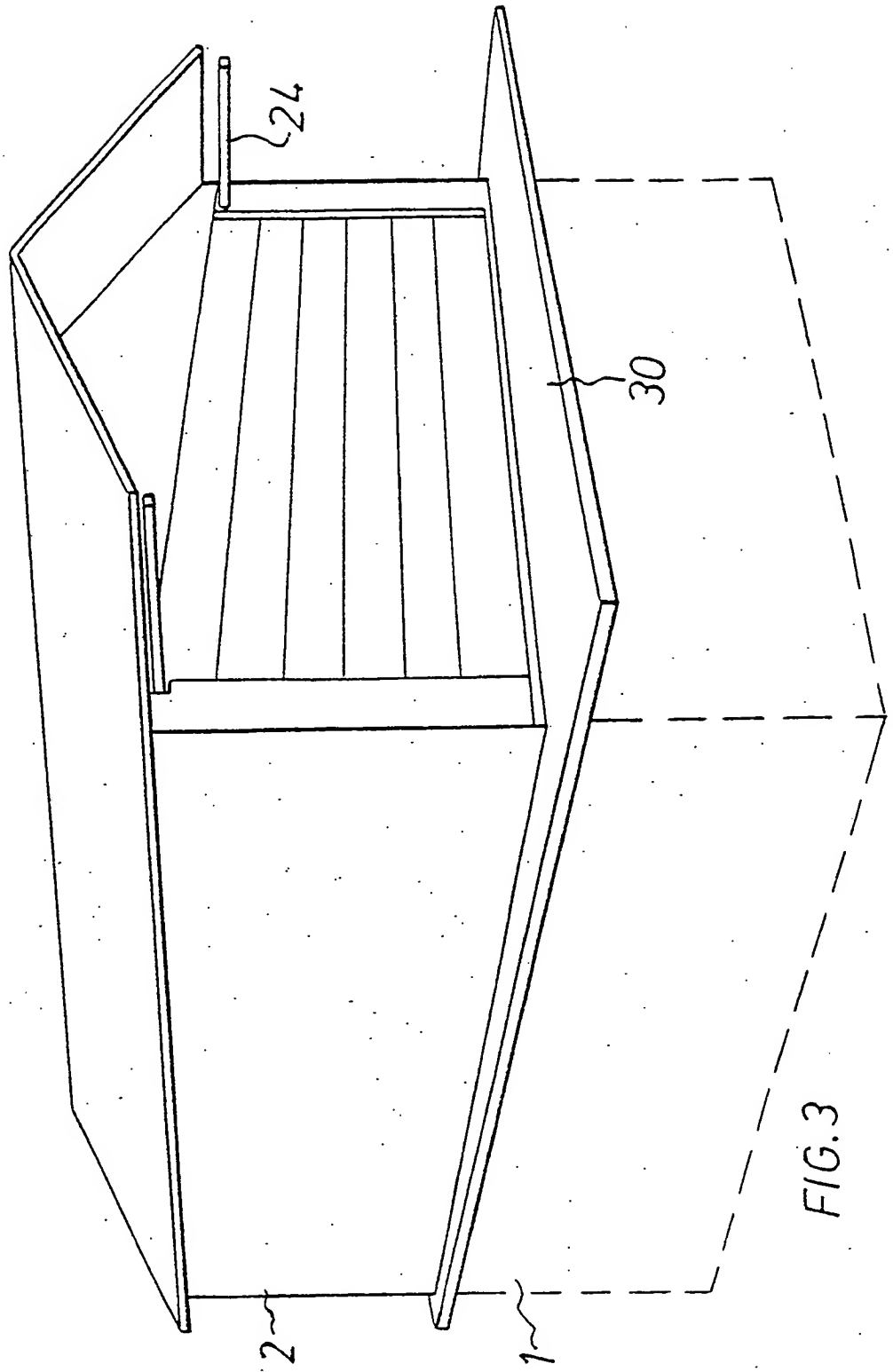



FIG.3

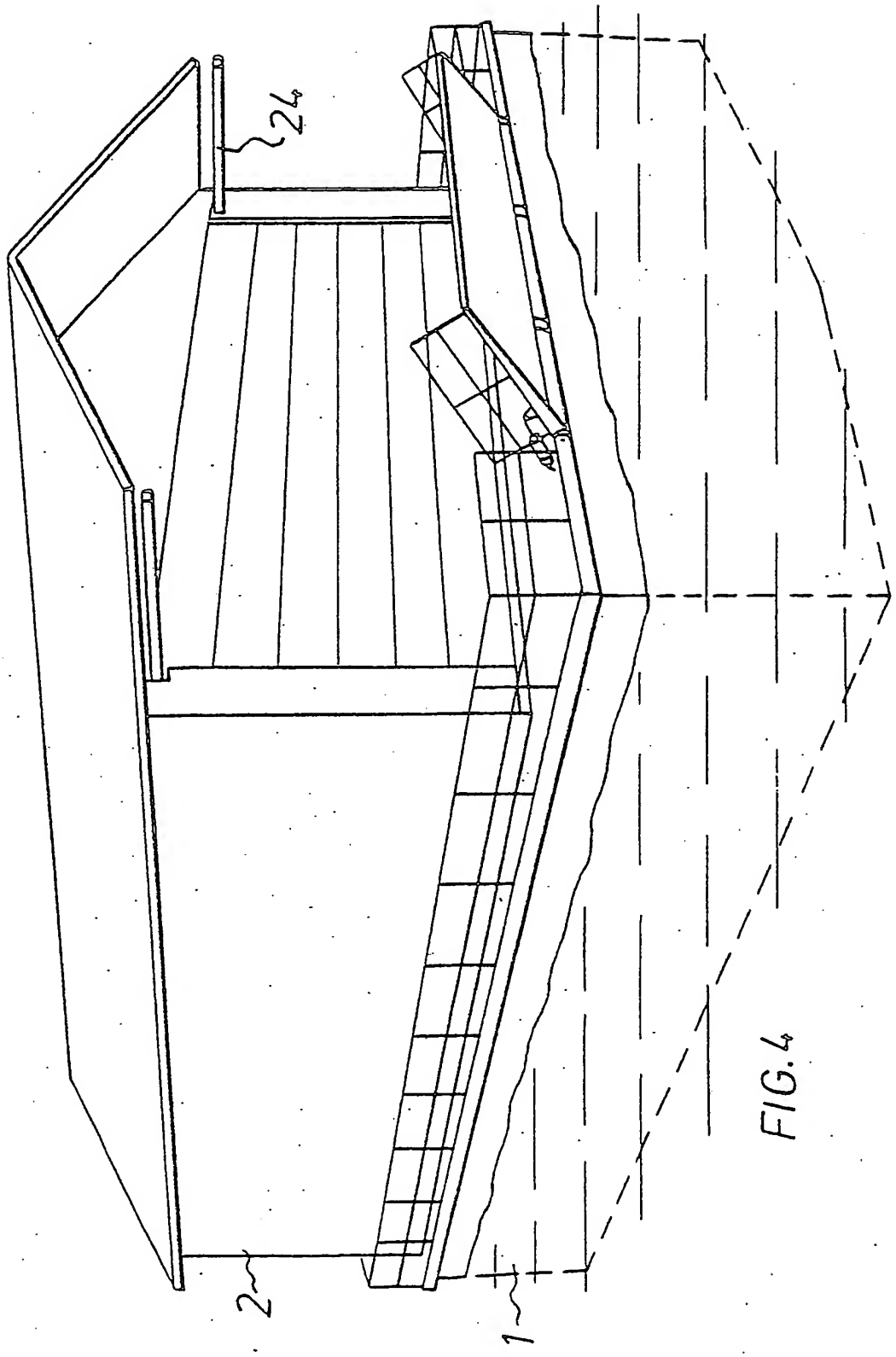
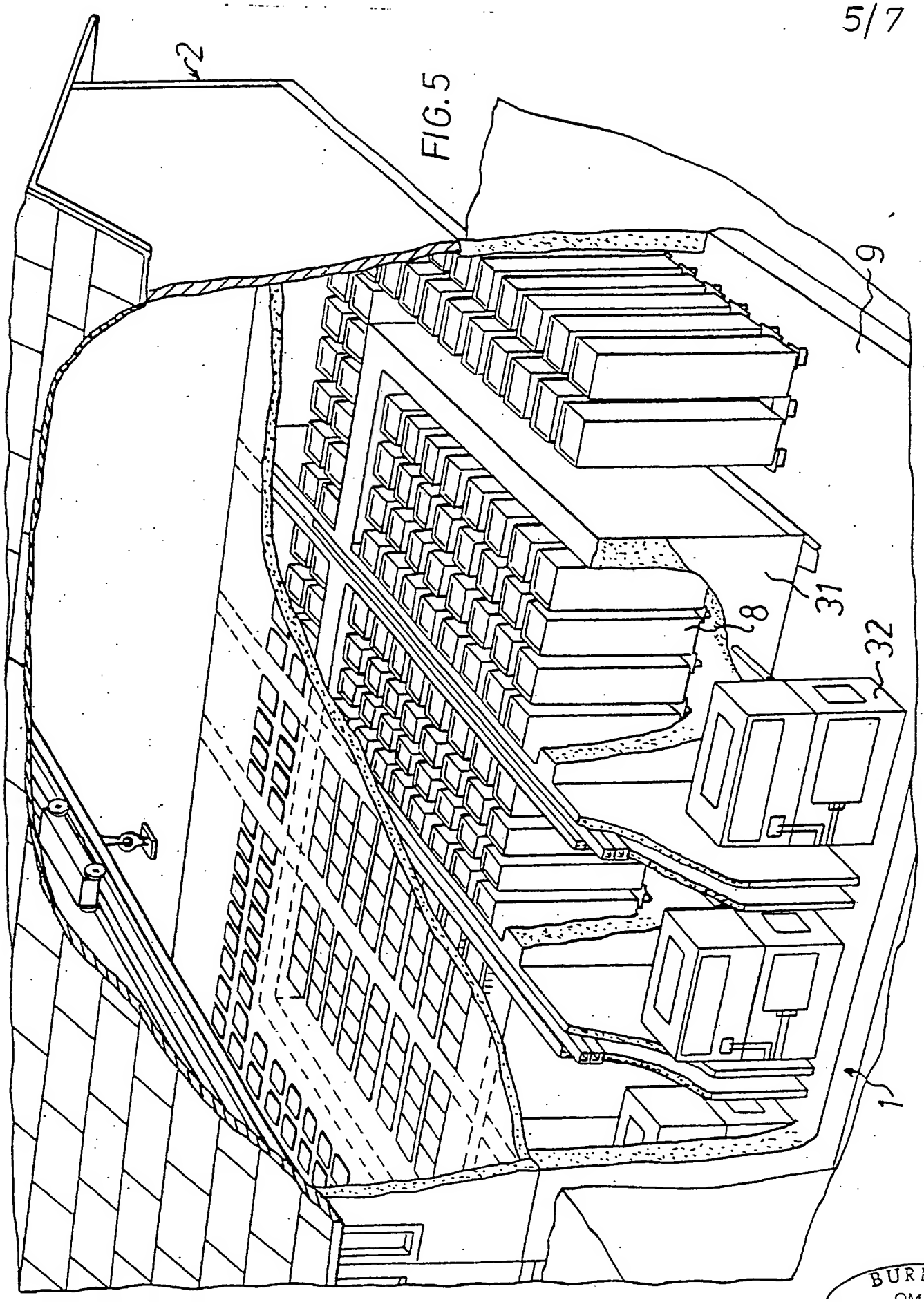



FIG. 4

FIG.5



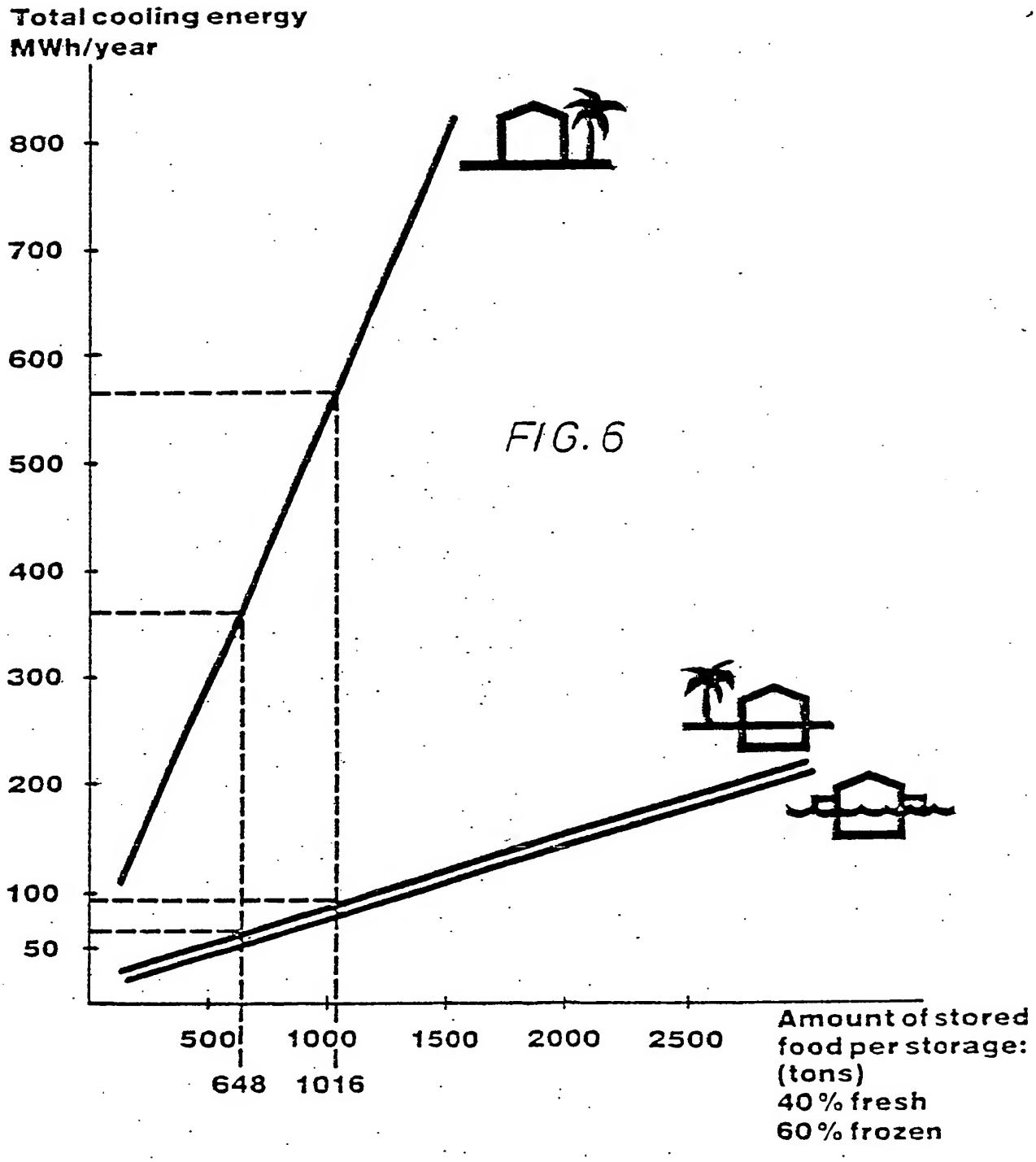



FIG. 6

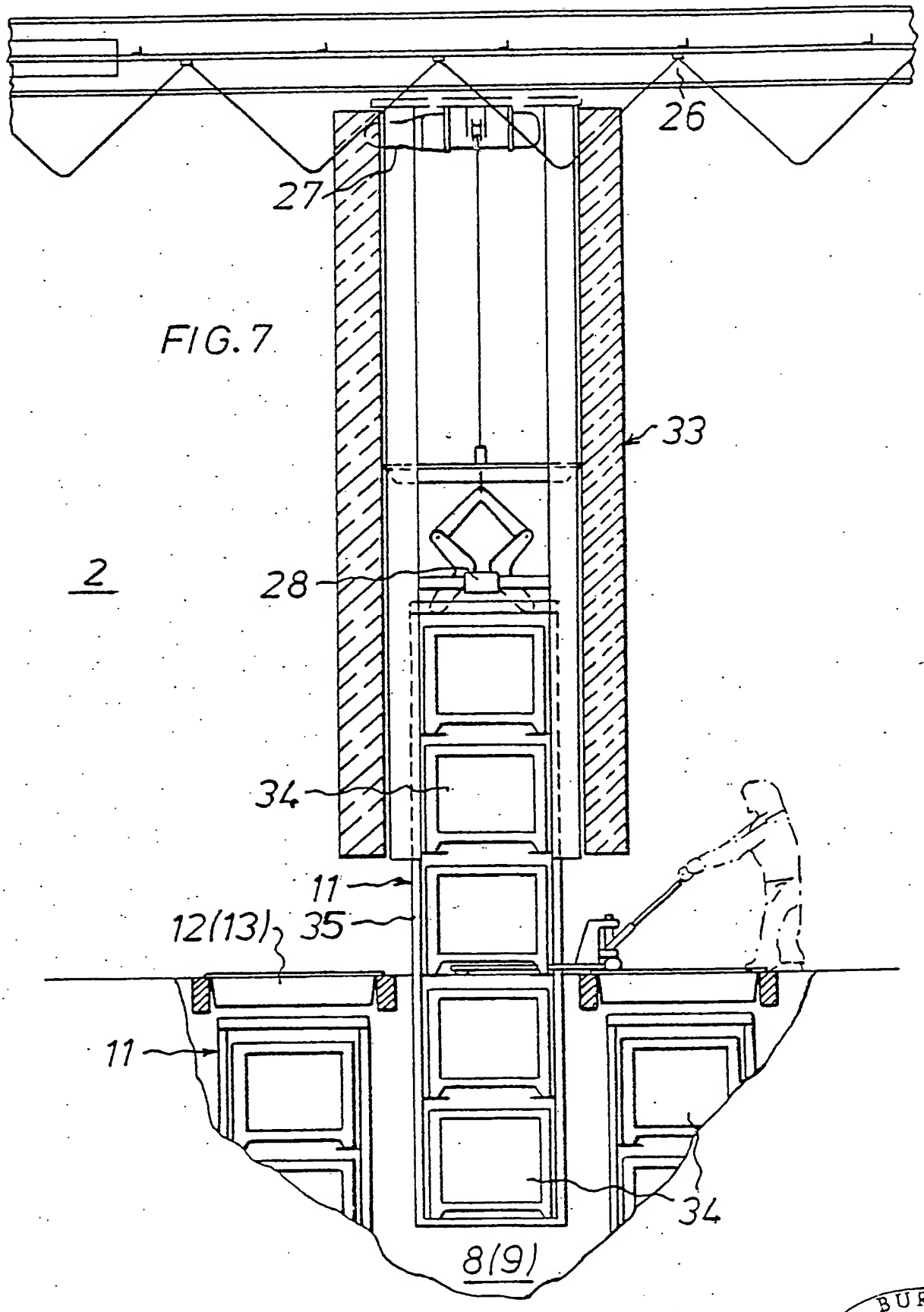



FIG. 7

# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE84/00247

## I CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC 3

F 25 D 13/04

## II. FIELDS SEARCHED

Minimum Documentation Searched [4]

| Classification System | Classification Symbols |
|---|---|
| IPC 3 | F 25 D 1/00, 13/00-06, 23/12, 25/00-04 |
| Nat Cl | 17c:1/01, 4/01 |
| US Cl | 62:265-266, 336-337, 278, 441-447; 165:45; 206:499 |

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [5]

SE, NO, DK, FI classes as above

## III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

| Category [6] | Citation of Document, [16] with indication, where appropriate, of the relevant passages [17] | Relevant to Claim No. [18] |
|---|---|---|
| Y | SE, C, 184 048 (AB ELEKTROLUX) 28 May 1963 | 1,2,4,5,6 |
| Y | GB, A, 632 545 (ORMOND ALEXANDER McKELLAR) 28 November 1949 | 1 |
| X | US, A, 602 239 (REYNOLDS) 26 April 1898 | 1,2,3,7,(8) |
| X | US, A, 842 595 (VASCONCELLES) 29 January 1907 | 1,2,3 |
| X | US, A, 911 879 (JACKSON) 9 February 1909 | 1,2,3 |
| X | US, A, 976 619 (BASKER) 22 November 1910 | 1,2 |
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## IV. CERTIFICATION

| Date of the Actual Completion of the International Search [3] | Date of Mailing of this International Search Report [3] |
|---|---|
| 1984-09-28 | 1984 -10- 05 |
| **International Searching Authority [1]** | **Signature of Authorized Officer [19]** |
| Swedish Patent Office | Magnus Thorén |

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

| Category * | Citation of Document, [16] with indication, where appropriate, of the relevant passages [17] | Relevant to Claim No [18] |
|---|---|---|
| X | US, A, 1 484 171 (CARSTENS) 19 February 1924 | 1,2,(4) |
| Y | US, A, 3 972 204 (SIDORENKO ET AL) 3 August 1976 | 7 |
| Y | SE, B, 350 563 (SO.DE.LE.S.N.C) 23 January 1969 | 9 |